REMARKS

In view of the above amendments and following remarks, reconsideration of the rejections contained in the Office Action of October 4, 2005 is respectfully requested.

Interview With Examiner Lund

Primary Examiner Jeffrie Lund is thanked for his courtesy in granting and conducting the interview with Applicants on December 21, 2005. It is believed that the discussions in the interview were quite useful. It is further hoped that the above amendments are along the lines of the suggestions made by the Examiner and will help to speed the allowance of the present application.

Proposed draft claims were presented to the Examiner during the interview. The Examiner agreed that the proposed amended claims appeared to overcome the rejection of record. However, the Examiner indicated that he would further review the claims when an amendment is received.

The above claims even further amend the claims, and it is respectfully submitted and believed that they clearly distinguish over all of the prior art of record. This will be discussed in detail below.

A Declaration Under 37 CFR 1.132 Accompanies This Response

As was discussed during the interview, Applicants have prepared and now filed a Declaration Under 37 CFR 1.132 regarding the nature and the advantages of the present invention over the prior art. The declaration is by the inventor Mr. Norio KIMURA, who was present at the interview. As will be now discussed, the declaration establishes that the present invention involves significant benefits and advantages that are not capable of being realized by the prior art.

As discussed in the declaration, the present invention detects a polishing end point of a first metal layer of a substrate during the polishing of the first metal layer using an end point monitor (e.g. 10-4, Fig. 8) that is disposed within a polishing table (10-1). After the polishing surface has been cleaned, the second metal layer is polished. The end point of the polishing of a second metal layer is detected using an optical film thickness monitor (10-15) that is also disposed within the polishing table. These types of monitors

are in-situ in that they are disposed within the polishing table in the polishing section (e.g. #10) of the polishing apparatus. While this means that the end points of the polishing can be determined during the polishing, without having to remove the substrate to determine the end point of polishing, thus making the measurement relatively quick, the accuracy of the detection is relatively low. This is because the monitors, being situated within the polishing table, essentially scan a line across the surface of the substrate, detecting at a relatively small number of points.

After the substrate has been moved from the polishing section, it is cleaned and dried. It is then moved to a dried condition film thickness measuring device (13) also disposed outside of the polishing section. The film thickness of the substrate is then measured with the dried condition film thickness measuring device.

As was discussed during the interview, and as is also discussed in the accompanying declaration, the fact of both in-situ measurement using the end point monitor and the optical film thickness monitor in the polishing table, in addition to using the in-line measurement with the dried condition film thickness measuring device, allows for significant advantages to be obtained. The in-line dried condition film thickness measuring device can sample at a much greater number of points, and provide for much greater accuracy. Accordingly, it can serve as a check or feedback to the end point monitors that are provided in the polishing table. That is, if it is determined, for example, that the results of detecting the end points of the polishing of the first metal layer and the second metal layer are imprecise, the end points can be adjusted.

The declaration of Mr. Kimura affirmatively establishes that the method according to the present invention allows for these advantages.

The Amended Claims

Each of independent claims 16, 23 and 41, the only independent claims now pending in the present application, reflect the method that allows for the advantages as discussed above.

All of the claims recite that the substrate is moved from a load/unload portion of a polishing apparatus to a polishing section of the apparatus. The first metal layer is then polished using a polishing surface and a first polishing fluid in the polishing section. A

polishing end point of the first metal layer is detected during the polishing of the first metal layer using an end point monitor that is disposed within the polishing table that comprises the polishing surface. This table is disposed with the polishing section of the apparatus, of course.

After the end point monitor has detected the end point of the polishing of the first metal layer, the polishing surface is cleaned by supplying water to remove the first polishing fluid. The second metal layer is then polished using the polishing surface and a second polishing fluid. The end point of the second metal layer polishing is detected using an optical film thickness monitor that is also disposed within the polishing table.

After detecting the polishing end point of the second metal layer, the substrate is moved from the polishing section. It is moved to a cleaning machine, and the substrate is then cleaned. After the substrate has been dried, it is moved to a dried condition film thickness measuring device that is also disposed outside of the polishing section.

The film thickness of the substrate, after having been dried, is measured using the dried condition film thickness measuring device. This result can be stored or can be used to decide whether the substrate should be transferred to a subsequent process. As discussed above, this result could also be used as feedback for the end point monitor and the optical film thickness monitor provided in-situ in the polishing table.

After the film thickness has been determined by the dried condition film thickness measuring device, the substrate is then moved from the dried condition film thickness measuring device to the load/unload portion.

The above steps are neither disclosed nor suggested by any of the prior art that has been cited by the Examiner.

<u>Claims 16, 23 and 41 Clearly Distinguish Over Lehman et al., Tsai et al. and Laursen et al.</u>

Claims 16 and 23 were rejected by the Examiner as being unpatentable over Laursen et al., U.S. Patent 6,555,466 (Laursen) in view of Lehman et al., U.S. Patent 6,621,264 (Lehman) and Tsai et al., U.S. Patent 6,117,780 (Tsai). However, while each of these references includes individual detection steps, none of them suggest the overall method of the present invention.

Laursen, noting for example column 2, lines 6-8, teaches that in a first step a semiconductor wafer is polished with a polishing pad and a first slurry until an end point is detected. This can be done by a variety of techniques known in the art, including the simple elapse of time. Noting column 3, beginning at line 9, Laursen again notes that a detected end point ends a first step of removing excess metal. This is followed by a second step which provides improved planarization. As noted in column 4, beginning at line 21, the first step of polishing is carried out until substantially all excess metal is removed. This first step is where the end point is detected.

Thus, it may be seen that Laursen only suggests one point of detecting film thickness, even though Laursen does discuss two polishing steps.

Laursen fails to disclose or suggest in-situ detection specifically, or detecting a polishing end point of the second metal layer, or an optical detector, or measurement of the film thickness after the substrate has been cleaned and dried outside of the polishing section. Thus Laursen clearly does not address the method of the present invention.

Tsai is directed to a chemical mechanical polishing method with in-line thickness detection. In this reference, it is noted that the Examiner referred to Fig. 1, which included a step of measuring thickness 270 after a wafer had been cleaned and dried. But it should be emphasized that this figure in fact refers to the prior art of Tsai.

Tsai specifically discusses the execution of thickness measurement of the semiconductor wafer being outside of the CMP equipment in column 2. It notes that if the thickness of the layer is not accepted, the CMP process must stay on that semiconductor wafer. Note column 2, lines 28-33. If a new process is started, the flow chart must start from the beginning, and this takes too much time and increases costs.

Tsai also discusses the prior art as disclosing an end-point detector which measures the thickness of the polished thin film layer in a small area during the CMP process. Note column 2 beginning at line 42. The problem identified by Tsai with this is that with this technique, measuring errors easily occur, and the thickness of the polished thin film layer cannot be accurately determined.

The result, in Tsai, then is that the CMP process itself is provided with in-line thickness measurement. Tsai specifically suggests that the wafers <u>not</u> be cleaned and

dried prior to in-line thickness measurement and without removing the wafers from the polishing section. Note the paragraph beginning at line 57 of column 2 of Tsai.

Tsai essentially then teaches in-line thickness measurement as an alternative to less accurate in-situ measurement, as discussed in column 1. It further teaches this type of in-line measurement as an alternative to removing the wafer, and cleaning and drying the wafer, prior to thickness measurement. Thus, in fact, Tsai appears to be even more remote from the present invention. It does not address detecting polishing end points of a first or a second metal layer during the first or second polishing steps. Nor does it address the measurement of the film thickness after the wafer has been cleaned and dried. Nor does it suggest that such could be combined with the in-situ detection steps.

Thus, Tsai also simply discloses one detection point, simply moving that point to a different physical location and a different point in the process.

Lehman is directed to the method of obtaining information in-situ regarding a film of a sample, primarily using an eddy probe. However, while Lehman discloses both an eddy-current device and an optical device, it is only directed to in-situ measurement. There is no suggestion of combining in-situ measurement with in-line thickness measurement as with the present invention.

Thus it may be seen that each of Lehman, Tsai and Laursen relate to only one or two steps, individually, of thickness measurement. There is nothing in any of these references, however, that suggests combining in-situ end point detection with in-line thickness measurement as required by each of the methods of claims 16, 23 and 41. That is, there is nothing from these references that suggest to one of ordinary skill in the art any reason to make a combination of in-situ end point detection for the first and second metal layers in combination with in-line thickness measurement, outside of the polishing section, after the wafer has been cleaned and dried. Rather, the references represent simple alternatives in thickness detection. There is nothing contained within the references that would motivate one of ordinary skill in the art to arrive at some combination of method steps that would be the same as those claimed.

Further, there is nothing in these references that enables the advantage that results from the combination of steps of the present invention. While the advantage of the

method steps of the present invention that is specifically discussed in the accompanying declaration by Mr. Kimura is not specifically addressed in the application itself, this does not mean that the combination of method steps does not have patentability. The references must still suggest a reason to combine the steps of the prior art into the claimed combination of steps. However, the art provides no such reasoning.

The Examiner's stated reasoning for combining the in-line film thickness measurement with the in-situ end point detection is "to determine the films thickness, and to determine if the polishing step is complete." The Examiner, it is believed, is relying upon the teachings of Tsai. However, as discussed above, this motivation is based upon prior art of Tsai, and Tsai itself specifically teaches away from thickness measurement after cleaning and drying, as discussed. Further, Tsai is not teaching any reasoning to motivate one of ordinary skill in the art to combine the in-line thickness detection with the in-situ detection. Rather, each of the references including Tsai teaches this measurement as a way of detecting when the polishing of the wafer is finished during the polishing step. It is not teaching a reason to combine such detection with an additional measurement of the film thickness.

Conclusion

From the above, it is respectfully submitted that all of the claims that now pend in the present application clearly distinguish over prior art to Laursen, Tsai and Lehman. Indication of such is, accordingly, requested. However, should the Examiner have any further concerns about the claim language, he is respectfully requested to contact Applicants' undersigned representative.

Respectfully submitted,

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